Claims

1. A manufacturing method of a semiconductor device, comprising the steps of:

supplying source gas obtained by vaporizing an organic source to a substrate; and thereafter

supplying gas excited by plasma for forming a conductive metal film.

2. The method of manufacturing the semiconductor device according to claim 1, wherein the source gas supplying step and the excited-gas supplying step are repeated plural times.

3. The method of manufacturing the semiconductor device according to claim 2, wherein the total film thickness of the conductive metal film is set to be 20 to 50nm.

4. The method of manufacturing the semiconductor device according to claim 1, wherein an annealing process is performed without performing a film quality improving process for removing impurities in the film after film formation.

5. The method of manufacturing the semiconductor device according to claim 1, wherein oxygen containing gas or nitrogen containing gas is excited by plasma and the gas thus excited by plasma is supplied in the excited-gas supplying step.

6. The method of manufacturing the semiconductor

device according to claim 1, wherein at least one kind of gas selected from a group of O_2, N_2O, Ar, H_2, N_2 and NH_3 is excited by plasma and supplied in the excited-gas supplying step.

7. The method of manufacturing the semiconductor device according to claim 1, wherein the source gas obtained by vaporizing the organic source is supplied to the substrate and adsorbed on the substrate in the source gas supplying step, and the gas excited by plasma is supplied to the substrate and caused to react with the organic source adsorbed on the substrate, thereby forming the film in the excited-gas supplying step.

8. The method of manufacturing the semiconductor device according to claim 1, further comprising the step of replacing the gas between the source gas supplying step and the excited-gas supplying step.

9. The method of manufacturing the semiconductor device according to claim 2, further comprising the step of replacing the gas between the source gas supplying step and the excited-gas supplying step, and between the excited-gas supplying step and the source gas supplying step.

10. The method of manufacturing the semiconductor device according to claim 1, wherein the conductive metal film is a capacitor electrode or a barrier metal film.

11. The method of manufacturing the semiconductor device according to claim 1, wherein the conductive metal film

is any one of the films selected from the group of an Ru film, an RuO_2 film, a Pt film, an Ir film, an IrO_2 film, a TiN film and a TaN film.

12. The method of manufacturing the semiconductor device according to claim 1, wherein the organic source supplied in the source gas supplying step is any one of the elements selected from the group of $Ru(C_2H_5C_5H_4)_2$, (bisethylcyclopentadienylruthenium), $(Ru(EtCp)_2$ for short), $Ru(C_5H_5)(C_4H_9C_5H_4)$, (butylruthenocene), $Ru[CH_3COCHCO(CH_2)_3CH_3]_3$, (tris 2, 4 octanedionatoruthenium), $Ru(C_2H_5C_5H_4)((CH_3)C_5H_5)$, (2,4 dimethylpentadienylethylcyclopentadienylruthenium), $(Ru(OD)_3$ for short), and $Ru(C_7H_8)(C_7H_{11}O_2)$, and the conductive metal film is either of an Ru film or an RuO_2 film.

13. The method of manufacturing the semiconductor device according to claim 1, wherein the organic source supplied in the source gas supplying step is any one of the elements selected form the group of $Ti[OCH(CH_3)_2]_4$, $Ti(OCH_2CH_3)_4$, $Ti[N(CH_3)_2]_4$, and $Ti[N(CH_3CH_2)_2]_4$, and the conductive metal film is a TiN film.

14. The method of manufacturing the semiconductor device according to claim 1, wherein the organic source to be supplied in the source gas supplying step is $Ta(C_2H_5O)_5$, and the conductive metal film is a TaN film.

15. The method of manufacturing the semiconductor device according to claim 1, wherein the source gas supplying

step and the excited-gas supplying step are performed at the temperature of 250°C to 350°C and with the pressure of 0.1 to several Torr.

16. A method of manufacturing a semiconductor device, comprising:

an initial film-forming step of forming a conductive metal film on a substrate; and

a main film-forming step of forming a conductive metal film on the film formed in the initial film-forming step,

the initial film-forming step comprising:

a source gas supplying step of supplying gas obtained by vaporizing an organic source to the substrate; and thereafter

an excited-gas supplying step of supplying gas excited by plasma, and

the main film-forming step, comprising:

a step of simultaneously supplying gas obtained by vaporizing an organic source and oxygen-containing gas or nitrogen-containing gas not excited by plasma.

17. The method of manufacturing the semiconductor device according to claim 16, wherein film thickness of the film formed in the initial film-forming step is set to be 5 to 15nm, and film thickness of the film formed in the main film-forming step is set to be 20 to 40nm.

18. The method of manufacturing the semiconductor

device according to claim 16, wherein the main film-forming step is a step of forming the film by thermal CVD, and the initial film-forming step and the main film-forming step are performed at the same temperature.

19. The method of manufacturing the semiconductor device according to claim 16, wherein

the initial film-forming step and the main film-forming step are performed at the temperature of 250°C to 350°C.

20. A substrate processing apparatus, comprising:

a processing chamber for processing a substrate;

a heater for heating the substrate in the processing chamber;

a source gas supply port for supplying an organic source gas for forming a conductive metal film in the processing chamber;

an exciting unit for exciting gas by plasma;

an excited-gas supplying port for supplying the gas excited by plasma into the processing chamber;

an exhaust port for exhausting interior of the processing chamber; and

a control unit for controlling the gas excited by plasma so as to be supplied to the substrate after organic source gas is supplied to the substrate.